United States Patent [19]

Byrd

[11] **3,737,998**

[45] **June 12, 1973**

[54] METHOD AND APPARATUS FOR MAKING ELECTRICAL CONNECTOR ASSEMBLIES

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[22] Filed: **Jan. 21, 1972**

[21] Appl. No.: **219,622**

[52] U.S. Cl. ..... **29/627**, 29/203 B, 29/203 P

[51] Int. Cl. **H05k 13/04**, H05k 3/28

[58] Field of Search ..... 29/DIG. 29, 203 B, 29/203 R, 627, 527.1, 527.5

[56] **References Cited**

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Primary Examiner—Thomas H. Eager

Attorney—Johnson, Dienner, Emrich, Verbeck & Wagner

[57] **ABSTRACT**

An insulative block is molded having a plurality of pin receiving openings with wide diameter head portions, where the cross sectional size of terminal pins is less than these head portions but greater than the remaining portion of the openings. A terminal pin insert machine is used to assemble the terminal pins comprising a base plate having a plurality of vertical openings formed downwardly from its upper surface, rig means for holding and aligning said terminal block on said base plate such that said pin receiving openings are in direct alignment with said vertical openings, and a guide plate assembly having a plurality of vertical passageways between its upper and lower surface, which is supported directly above the terminal block with its vertical passageways in direct alignment with the pin receiving openings. The vertical passageways of the guide plate assembly have an intermediate portion of identical cross sectional shape and slightly larger size than said terminal pins to hold said terminal pins in a perpendicular relation to said terminal block when in the loading position. Press means are provided for engaging the tops of said terminal pins and driving them down into the pin receiving openings to provide an interference fit therewith.

22 Claims, 11 Drawing Figures

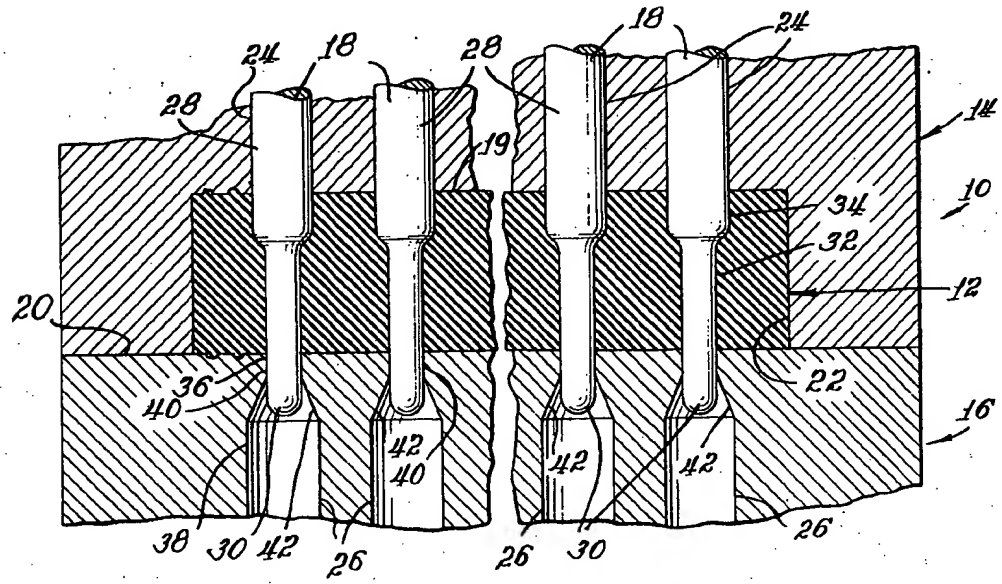


Fig. 1

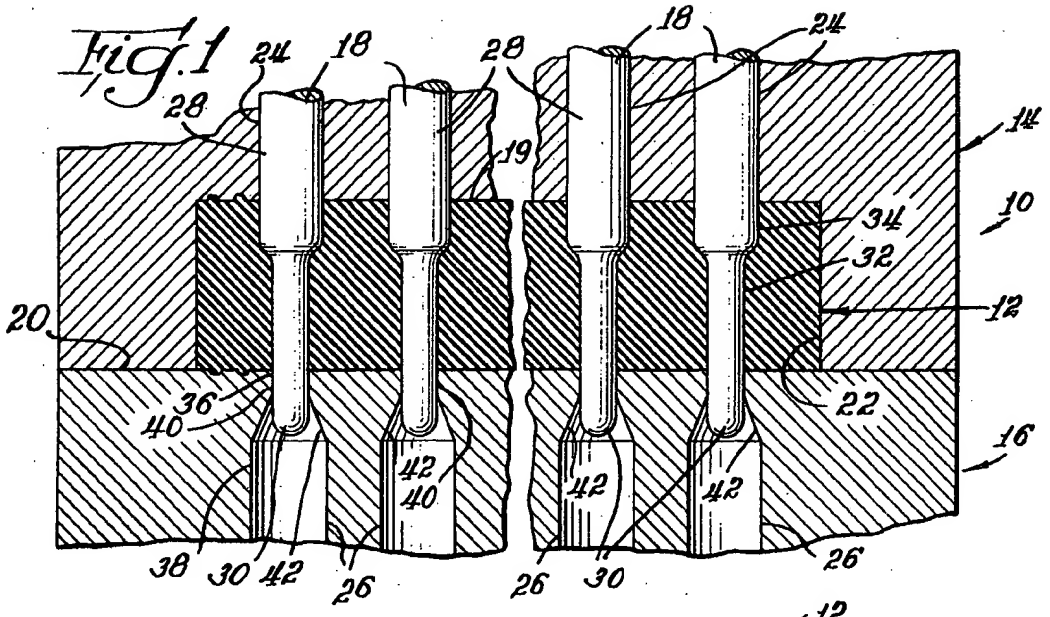


Fig. 3

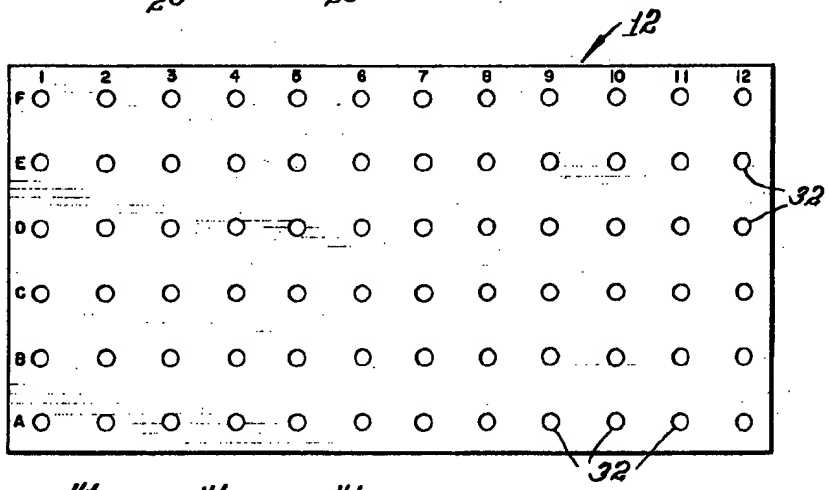


Fig. 4

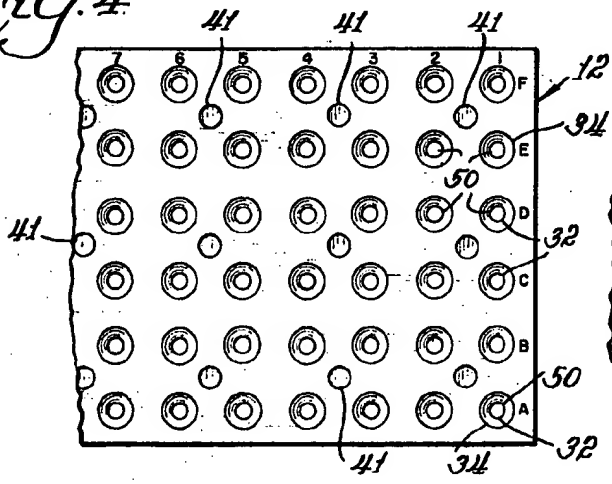
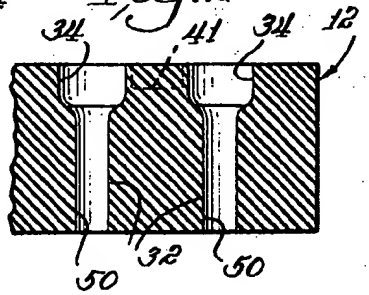


Fig. 2



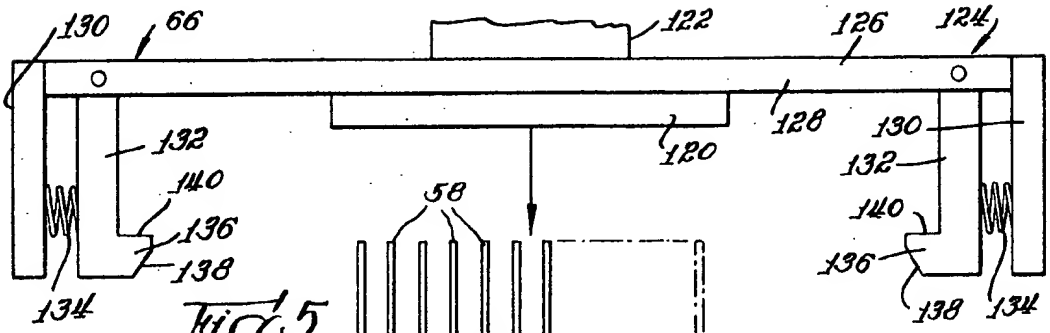


Fig. 5

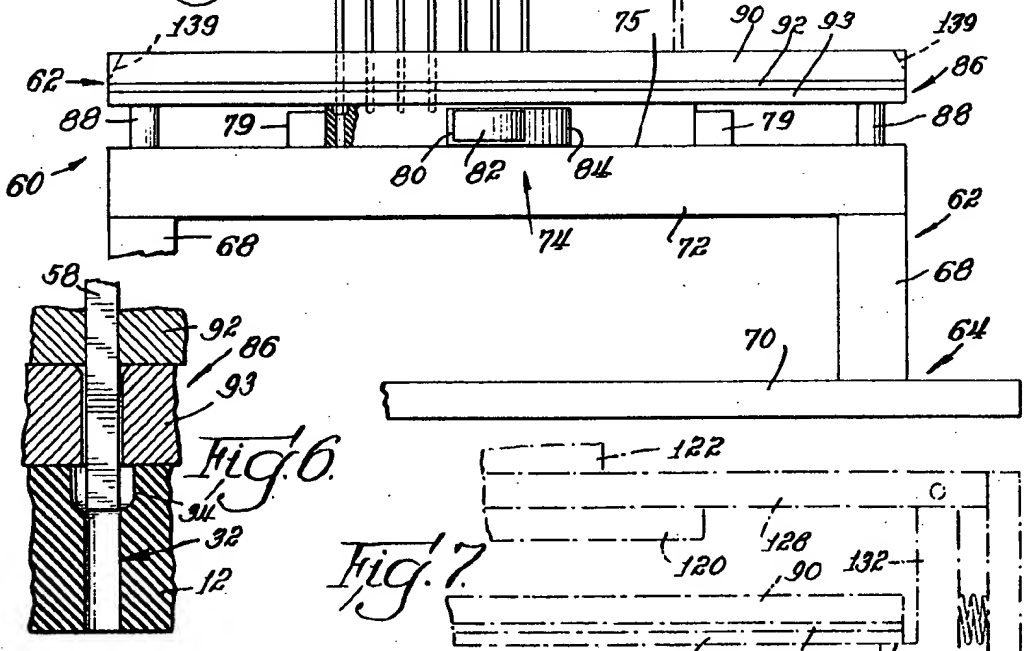


Fig. 6

Fig. 7

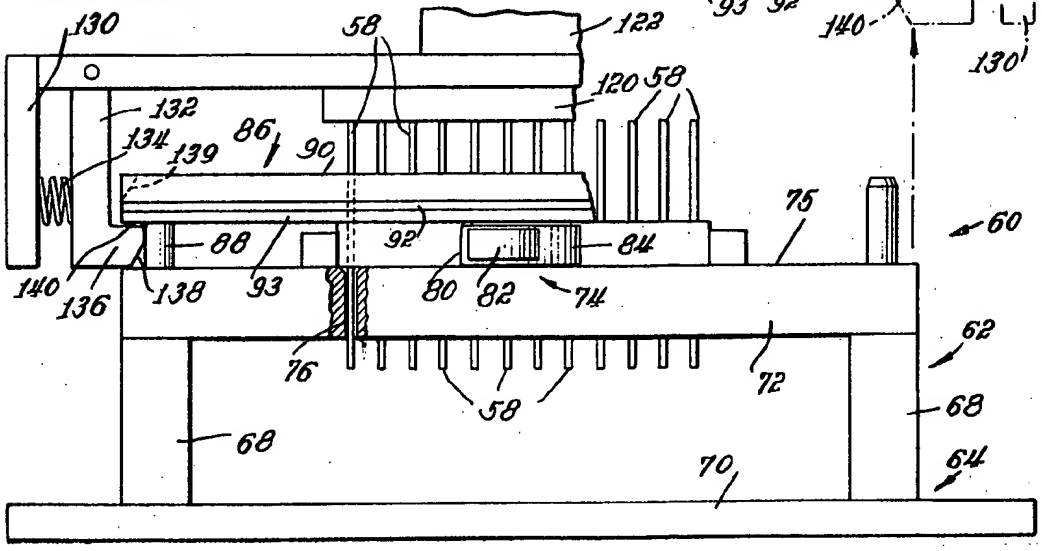
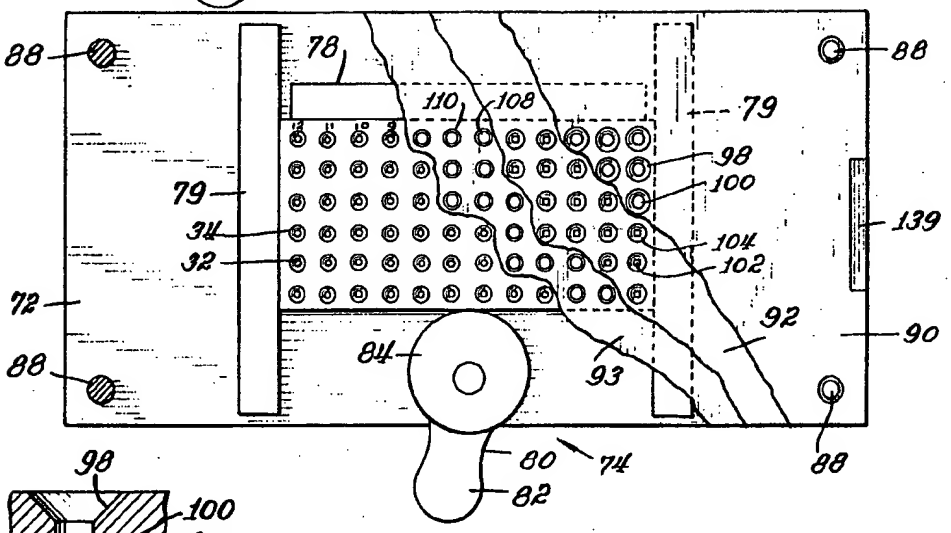


Fig. 8.



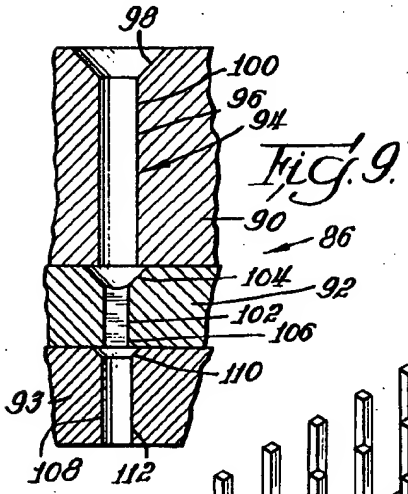


Fig. 9.

Fig. 10.

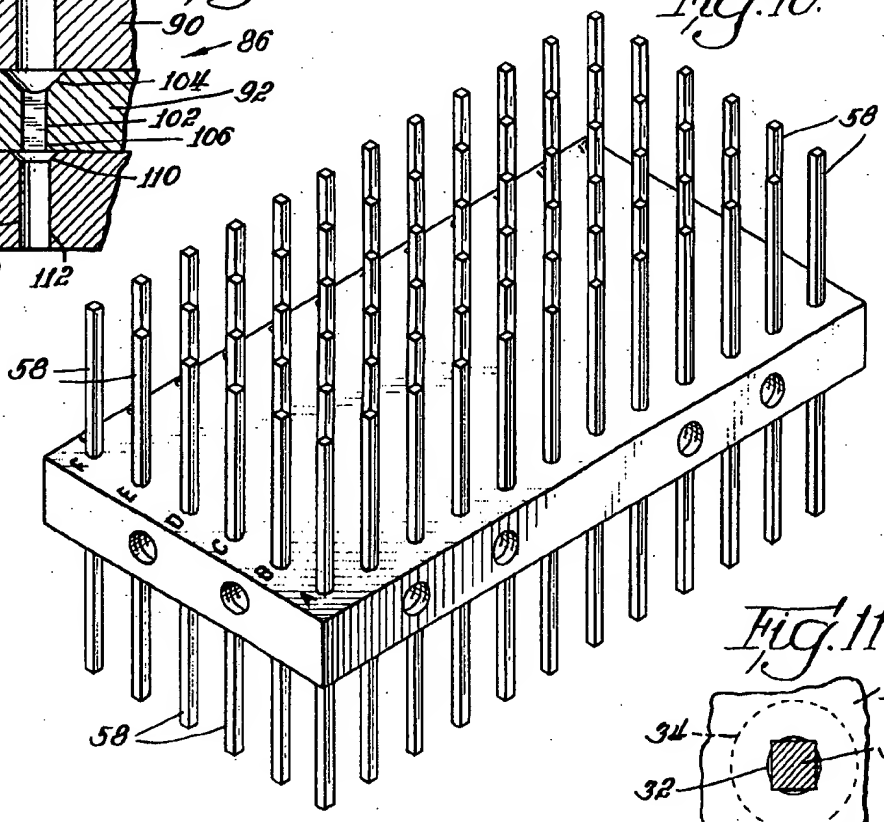


Fig. 11.

METHOD AND APPARATUS FOR MAKING ELECTRICAL CONNECTOR ASSEMBLIES

BACKGROUND OF THE INVENTION

This invention relates to a method and apparatus for making terminal block assemblies.

The conventional process for constructing terminal block assemblies suitable for wire wrap connections is to place a multitude of terminal pins in a restraining mechanism and mold an insulative compound around the pins. To allow sufficient holding force on the pins, it is necessary that the center of each pin be distorted to provide a torque to resist displacement between the pin's center portion and the mold. Both material and labor costs for this terminal block construction are relatively high due to the need to use expensive materials and the number of time-consuming operations.

One object of this invention is to provide a new method and apparatus for making terminal block assemblies using comparatively low cost, pre-molded insulating blocks.

A further object of this invention is to provide a new method and apparatus for making terminal block assemblies which require fewer process steps and less time than heretofore possible.

A still further object of this invention is to provide a new method and apparatus for making terminal block assemblies in which terminal pins are simultaneously driven into an interference fit with preformed openings in a pre-molded insulative block.

The above and further objects, features and advantages of this invention will be apparent to those skilled in the art from the following detailed description of a preferred embodiment of its concepts as found in the accompanying drawings.

SUMMARY OF THE INVENTION

One aspect of this invention is the process for molding an insulating terminal block in which a series of telescoping mold pins are used to precisely determine the location, size and shape of the terminal pin openings.

The pre-molded insulative terminal blocks are then sandwiched between an upper guide plate assembly and lower base plate such that its preformed openings are in alignment with openings provided in both the guide plate assembly and base plate. The terminal pins are fed into a loading position through the openings in the guide plate assembly and a pressure plate drives the terminal pins into an interference fit with the preformed openings of the terminal block.

To increase the efficiency of installing the terminal pins bracket means are provided to align and hold the premolded terminal block on the base plate and pick-up means for lifting the guide plate assembly away from the terminal block after the pins are inserted.

DESCRIPTION OF DRAWINGS

For a better understanding of this invention reference may be made to the accompanying drawings, in which:

FIG. 1 is a cross sectional view of the mold used to make insulative terminal block in accordance with the principles of this invention;

FIG. 2 is a partial cross sectional view of an insulative terminal block formed in the mold of FIG. 1;

FIGS. 3 and 4 are, respectively, bottom and top views of the insulative terminal block shown in FIG. 2;

FIG. 5 is a front elevational view of a terminal pin insert machine used to insert terminal pins into the insulative blocks of FIG. 2 in accordance with the principles of this invention;

FIG. 6 is a partial sectional view of FIG. 5 showing the lower portion of a terminal pin in a loading position and extending through a passageway in the upper guide plate assembly and into the lead portion of the pin receiving openings in the insulative terminal block;

FIG. 7 is a front elevational view of the pin insert machine of FIG. 5 with the position of its press unit shown in solid lines after the pins are inserted, and shown in phantom lines in the retracted position;

FIG. 8 is a top plan view of pin insert machine taken below the press unit;

FIG. 9 is a partial cross sectional view of the guide plate assembly;

FIG. 10 is a perspective view of a terminal block assembly; and

FIG. 11 is an enlarged cross sectional view taken across one of the pin receiving openings of the terminal block assembly of FIG. 10.

DESCRIPTION OF PREFERRED EMBODIMENT

Referring to FIG. 1, there is depicted a partial sectional view of a mold 10 for making an insulative terminal block 12. Mold 10 comprises upper and lower mold sections 14, 16 and a plurality of telescopic mold pins 18. Upper mold section 14 has a rectangular-shaped shallow recess 19, which when placed over upper flat surface 20 of lower mold section 16 defines a mold cavity 22.

The telescopic pins 18 extend perpendicularly through the mold cavity 22 between upper circular passageways 24 formed in upper mold section and complementary lower passageways 26 provided through lower mold section 16. Telescopic pins 18 have a wide circular base portion 28 and a rounded narrow end portion 30. The lower end of the base portion 28 extends into mold cavity 22 so as to form counterbore openings 32 (FIG. 2) having a wide head portion 34 in the molded terminal block 12.

One improvement provided by this invention is the formation of mold openings 32 having no transverse flash across their entrances, which are frequent occurrences in conventional compression or transfer molds, and are obstacles to proper connector pin alignment. This improvement is provided by virtue that the lower narrow end of the telescopic pins 18 is of a sufficient length to extend into the lower passageway 26 and shape of passageway 26 is made with a land area 36 for shutoff of the molding material and a cleared-out area 38 for collection and removal of the material that loads the mold pins. Land area 36 is presented by the circular collar portion 40 at the inner end of passageway having a diameter slightly larger than that of narrow pin end portion 30. The cleared-out area 38 includes conical section 42 below collar portion 40.

By making the telescopic mold pins to extend into lower passageway 26, they are rigidly supported to withstand the lateral pressures presented during the injection step. To evenly distribute the molding material throughout the mold cavity 22, an injection opening is provided at the center of each group of four upper passageways 24 in upper mold section 14. The size and lo-

cation of these openings are represented by circular recesses 41 in the molded block 12 (FIGS. 2 and 4).

To make a terminal block, the mold sections are aligned together as illustrated in FIG. 1, the telescopic pins are inserted in the upper and lower mold sections as shown and mold cavity 22 is then filled as by injection with a suitable plastic material through the various injection openings. Before the mold reaches the curing stage, telescopic pins 18 are removed, and because their lower narrow end 30 extends down into passageway 26, there is no resulting flash over across the pin receiving openings 32. The resulting product is a narrow rectangular-shaped terminal block 12 (FIGS. 2–4) having a multitude of terminal pin receiving openings 32 arranged in parallel columns and rows. These openings 32 are provided with an enlarged diameter head portion 34 which is used as a lead for the terminal pins during assembly. The remaining portion 50 of the pin receiving openings has a circular cross section of a size smaller than the cross sectional size of the connector pins to be inserted therein.

The method and apparatus for mounting the connector pins in the terminal blocks will now be described. Referring to FIG. 5, there is shown a pin insert machine generally designated by the reference numeral 60 specially designed to assemble simultaneously a large number of terminal pins 58 into terminal block 12. Pin insert machine 60 comprises an alignment unit 62 supported on base frame 64, and a press unit 66 supported above alignment unit 62 and operative to reciprocate toward and away from the alignment unit.

Base frame 64 consists of a pair of spaced support columns 68 upstanding from horizontal plate 70. Base plate 72 of alignment unit 62 is suspended between the upper ends of the support columns 68. A rig 74 for holding the terminal block rigidly in place is carried on the upper surface 76 of base plate 72. Rig 74 (FIG. 8) is designed to quickly mount the terminal block so that its pin receiving openings are in direct alignment with a plurality of openings 76 formed through base plate 72. Rig 74 (FIG. 8) comprises a rear bar 78 disposed between a pair of parallel side bars 79 spaced apart the length of the terminal block 12, and a rotatably mounted lever 80 having a handle 82 and eccentric portion 84.

In addition to base plate 72 and rig 74, alignment unit 62 comprises a guide plate assembly 86 which is supported above base plate 72 by means of four vertical mounting posts 88. Guide plate assembly 86 is made up of three sections: upper guide plate 90, intermediate alignment plate 92, and lower guide plate 93. Alignment openings or passageways 94 are formed through these three plates, and are in direct alignment with the pin receiving openings 32 when guide plate assembly 86 is placed on mounting posts 88.

The size and shape of alignment openings 94 (FIG. 9) are different for each of the three plates 90, 92 and 93. The upper portion 96 of alignment opening 94 formed in upper guide plate 90 has a beveled head 98 and a relatively large diameter body section 100 to permit the terminal pins to be quickly inserted into the alignment openings 94. The intermediate portion 102 of alignment opening 94 has a beveled head portion 104 slightly larger at its upper end than the diameter of body section 100 which blends into the cross sectional shape of the terminal pins to form the body section 106. The cross sectional size of square body section 106 in the preferred embodiment is square having a size slightly larger than the cross section of square terminal pins 58 and causes all the terminal pins to have the same orientation relative to the pin receiving openings 32. The lower portion 108 formed in lower guide plate 92 comprises a beveled head 110 and circular body portion 112 having a cross sectional size slightly greater than that of the terminal pins. Lower portion 108 of alignment passageway 94 guide the terminal pins into pin receiving openings of the pre-molded terminal block. The intermediate and lower portions 102, 108 perform the very important function of holding the terminal pins perpendicular to terminal block so that they may be driven straight into pin receiving openings 32.

The three plates 90, 92 and 93 may be permanently bonded together or temporarily fastened together, as by screws. Their combined thickness is equal to the length the terminal pins 32 will extend above the terminal block 12, so it is advantageous to fasten the plates together in order to permit varying their combined thickness.

Press unit 66 comprises a pressure plate 120 disposed above guide plate assembly 86, and reciprocating drive means 122 for moving pressure plate 120 into driving engagement with the terminal pins located in the loading position. Reciprocating drive means 122 could be any of a number of well known hydraulic or pneumatic presses, such as a punch press.

Disposed between the pressure plate 120 and reciprocating drive means 122 is a pick-up device 124 for automatically removing the guide plate assembly upon completion of the terminal pin assembly operation. Pick-up device 124 consists of a frame 126 having a cross bar 128 and two downwardly extending support arms 130 and a pair of spring-biased latching levers 132, which are pivotally mounted at the upper ends on cross bar 128 adjacent support arms 130. A spring 134 is sandwiched between the lower ends of each pair of latching lever 132 and support arm 130 urging the inturned latching fingers 136 on the lower end of levers 132 towards each other. Latching fingers 136 include a cam surface 138 adapted to strike the ramp surfaces 139 (FIG. 8) at opposite outside corners of guide plate assembly 86 for spreading the latching fingers 136 apart until the upper shoulder portions 140 ride past the lower outside corners at which time the fingers 136 snap into their latching position. On the upstroke, shoulder portions 140 engage the lower outside corners and lift the guide plate assembly away from the terminal block to the phantom position of FIG. 7. To complete the operation, the rig 74 is unclamped and the terminal block assembly is removed.

From the foregoing description, it will be appreciated that this invention encompasses an economical and simple design for molding insulative terminal blocks in which telescopic mold pins are used to form terminal pin receiving openings with precision as to location, size and shape. These mold pins employ a large base to provide lateral strength to withstand injection pressures and shape the lead portion of the terminal pin openings. The resultant molded openings have no transverse flash across their lower end. This is a very important feature since transverse flash across the openings would prevent terminal pin alignment during assembly.

My invention permits the use of pre-molded insulative blocks of comparatively low cost material and to

drive cut-to-length pins individually or in groups into an interference fit with pin receiving openings in the insulative blocks. The insulative blocks could be as well made of other insulative materials such as wood.

An important feature of my invention is to employ various cooperating guide plates to align the terminal pins with respect to the pin receiving openings prior to applying a driving force so that the pins are held in a perpendicular relation with respect to the insulative block and in a desired angular or rotational orientation with respect to each other.

I claim:

1. The method of making a terminal block assembly composed of a plurality of terminal pins inserted through preformed pin receiving openings in an insulative terminal block where the cross sectional size of said terminal pins is greater than the smallest cross sectional dimensions of said preformed opening, comprising the steps of:

a. positioning said terminal block on a base plate having a set of openings therethrough such that said pin receiving openings are in alignment with said set of openings,

b. positioning a guide plate assembly having a plurality of passageways therethrough such that said passageways are in alignment with said pin receiving openings,

c. inserting a plurality of terminal pins into said plurality of passageways, where at least a portion of each passageway has a cross sectional size slightly greater than that of said terminal pins to support said terminal pins in a perpendicular relation with said terminal block, and

d. simultaneously applying a pressure to the upper end of said terminal pins of sufficient magnitude to drive the lower portion of said pins through said pin receiving openings and provide an interference fit between an intermediate portion of said pins and said preformed openings.

2. The method of claim 1, wherein said step of applying pressure on said terminal pins comprises moving a pressure plate larger than said insulative terminal block downwardly along a path perpendicular to said terminal pins into engagement with the upper ends of said terminal pins and driving said pins inwardly of said pin receiving openings until said pressure plate abuts against the upper surface of said guide plate assembly.

3. The method of claim 2, further comprising the step of raising said pressure plate to its starting position and simultaneously lifting said guide plate assembly above said terminal block a sufficient distance to allow the terminal block assembly to be readily removed.

4. The method of making an insulative terminal block having a plurality of spaced pin receiving openings for mounting a plurality of terminal pins, comprising the steps of

a. placing an upper mold section having a shallow recess in its lower surface and a plurality of spaced vertical openings between said shallow recess and its upper surface on a lower mold section to define a mold cavity therein, said lower mold section having a plurality of complementary vertical passageways extending downwardly from its upper surface in direct alignment with said vertical openings,

b. inserting a telescopic mold pin having a wide base portion and narrow end portion down into each of said vertical openings such that said base portion makes a snug fit with said vertical opening and extends a small distance into said mold cavity, and said narrow end portion extends through said mold cavity and projects through and beyond the entrance portion to said vertical passageway making a snug fit at said entrance portion, and

c. filling said mold cavity with a thermosetting material.

5. The method of claim 4, wherein the cross section of said vertical passageways increases inwardly of said entrance portion to provide a cleared-out area for collection and removal of the excess thermosetting material.

6. The method of making a terminal block assembly composed of an insulative terminal block having a plurality of spaced terminal pin receiving openings and a plurality of terminal pins inserted through said pin receiving openings, comprising the steps of

a. placing an upper mold section having a shallow recess in its lower surface and a plurality of spaced vertical circular openings between said shallow recess and its upper surface on a lower mold section to define a mold cavity therein; said lower mold section having a plurality of complementary vertical passageways extending downwardly from its upper surface in direct alignment with said vertical openings,

b. inserting a telescopic mold pin having a wide circular base portion and a narrow circular end portion down into each of said vertical circular openings where the diameter of said base portion is slightly less than said circular opening to make a snug fit with said vertical opening and extends a small distance into said mold cavity, and said narrow end portion extends through said mold cavity and projects through and beyond the entrance portion to said vertical passageway making snug fit at said entrance portion,

c. filling said mold cavity with a thermosetting material,

d. heating and curing the mold to form a rigid insulative terminal block with said pin receiving opening having a wide lead portion,

e. positioning said terminal block on a base plate having a set of openings therethrough such that said pin receiving openings are in alignment with said set of openings,

f. positioning a guide plate assembly having a plurality of passageways therethrough such that said passageways are in alignment with said pin receiving openings,

g. inserting a plurality of terminal pins having a cross sectional size less than said wide lead portion but greater than the remaining portion of said pin receiving openings into said plurality of passageways where at least a portion of each passageway has a cross sectional size slightly greater than that of said terminal pins to support said terminal pins in a perpendicular relation with said terminal block, and

h. simultaneously applying a pressure to the upper end of said terminal pins of sufficient magnitude to drive the lower portion of said pins through said pin receiving openings and provide an interference fit between an intermediate portion of said pins and said remaining portion of said pin receiving openings.

7. The method of claim 6, wherein said step of applying pressure on said terminal pins comprises moving a pressure plate larger than said insulative terminal block downwardly along a path perpendicular to said terminal pins into engagement with the upper ends of said terminal pins and driving said pins inwardly of said pin receiving openings until said pressure plate abuts against the upper surface of said guide plate assembly.

8. The method of claim 7, further comprising the steps of raising said pressure plate to its starting position and simultaneously lifting said guide plate assembly above said terminal block a sufficient distance to allow the terminal block assembly to be readily removed.

9. The method of claim 6, wherein the diameter of said vertical passageways increases inwardly of said entrance portion to provide a cleared-out area for collection and removal of the excess thermosetting material.

10. An apparatus for inserting terminal pins into pin receiving openings preformed in a spaced relation through an insulative terminal block where the cross sectional size of said pins is greater than the smallest cross sectional dimensions of said openings, comprising a base plate having a plurality of vertical openings formed downwardly from its upper surface, rig means for holding and aligning said terminal block on said base plate such that said pin receiving openings are in direct alignment with said vertical openings, guide plate assembly having a plurality of vertical passageways between its upper and lower surface, mount means carried by said base plate for supporting said guide plate assembly directly above said terminal block with said vertical passageways in direct alignment with said pin receiving openings, said vertical passageways having an intermediate portion of identical cross sectional shape and slightly larger size than said terminal pins to hold said terminal pins in a perpendicular relation to said terminal block when in the loading position, and press means for engaging the tops of said terminal pins and driving them down into said pin receiving openings to provide an interference fit between the intermediate portion of said terminal pins and said smallest cross sectional dimension of said pin receiving openings.

11. An apparatus as defined in claim 10, wherein the upper portion of said vertical passageways in said guide plate assembly has a substantially wider cross section than said terminal pins with an enlarged head area to guide said terminal pins into said vertical passageways.

12. An apparatus as defined in claim 10, wherein the thickness of said guide plate assembly equals the desired length of said terminal pins projecting above said terminal block.

13. An apparatus as defined in claim 10, wherein said press means comprises a pressure plate disposed above said guide plate assembly of a size greater than the space array of said pin receiving openings and reciprocal drive means for moving said plate down into driving engagement with said terminal pins to force said terminal pins into an interference fit with said pin receiving openings and returning said plate to its starting position.

14. An apparatus as defined in claim 13, further comprising pick-up means for lifting said plate guide assembly above said terminal block during the return stroke of said reciprocal drive means.

15. An apparatus for inserting terminal pins into circular pin receiving openings having a wide lead portion preformed in a spaced relation through an insulative terminal block where the cross sectional size of said pins is less than said wide lead portion but greater than the remaining portion of said openings, comprising a base plate having a plurality of vertical openings formed downwardly from its upper surface, rig means for holding and aligning said terminal block on said base plate such that said pin receiving openings are in direct alignment with said vertical openings, guide plate assembly having a plurality of vertical passageways between its upper and lower surface, mount means carried by said base plate for supporting said guide plate assembly directly above said terminal block with said vertical passageways in direct alignment with said pin receiving openings, said vertical passageways having an intermediate portion of identical cross sectional shape and slightly larger size than said terminal pins to hold said terminal pins in a perpendicular relation to said terminal block when in the loading position, and press means for engaging the tops of said terminal pins and driving them down into said remaining portion of said pin receiving openings to provide an interference fit therewith.

16. An apparatus as defined in claim 15, wherein the upper portion of said vertical passageway in said guide plate assembly is curcular of a substantially wider cross section than said terminal pins with an enlarged head to guide said terminal pins into said vertical passageways.

17. An apparatus as defined in claim 15, wherein said press means comprises a pressure plate disposed above said guide plate assembly of a size greater than the space array of said pin receiving openings and reciprocal drive means for moving said plate down into driving engagement with said terminal pins to force said terminal pins into an interference fit with said pin receiving openings and returning said plate to its starting position.

18. An apparatus as defined in claim 17, further comprising pick-up means for lifting said plate guide assembly above said terminal block during the return stroke of said reciprocal drive means.

19. An apparatus as defined in claim 15, wherein said guide plate assembly comprises an upper guide plate, an intermediate alignment plate and a lower guide plate, where the portion of said vertical passageways extending through said upper guide plate comprises a beveled head blending into a circular body section having a cross section substantially larger than the cross section of said terminal pins.

20. An apparatus as defined in claim 19, wherein the portion of said vertical passageways extending through said intermediate alignment plate comprises a conical head slightly larger at its upper end than the diameter of said circular body section and at its lower end blending into a body section having the same cross sectional shape of said terminal pins and a slightly larger cross sectional size.

21. An apparatus as defined in claim 20, wherein the portion of said vertical passageway extending through said lower guide plate comprises a downwardly tapered head blending into a cylindrical body section of a cross sectional slightly greater than the cross section of said terminal pins.

22. An apparatus as defined in claim 19, wherein the combined thickness of said upper guide plate, intermediate guide plate and lower guide plate is selected to equal the desired length of extension of said terminal pins above said insulative block after assembly.

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